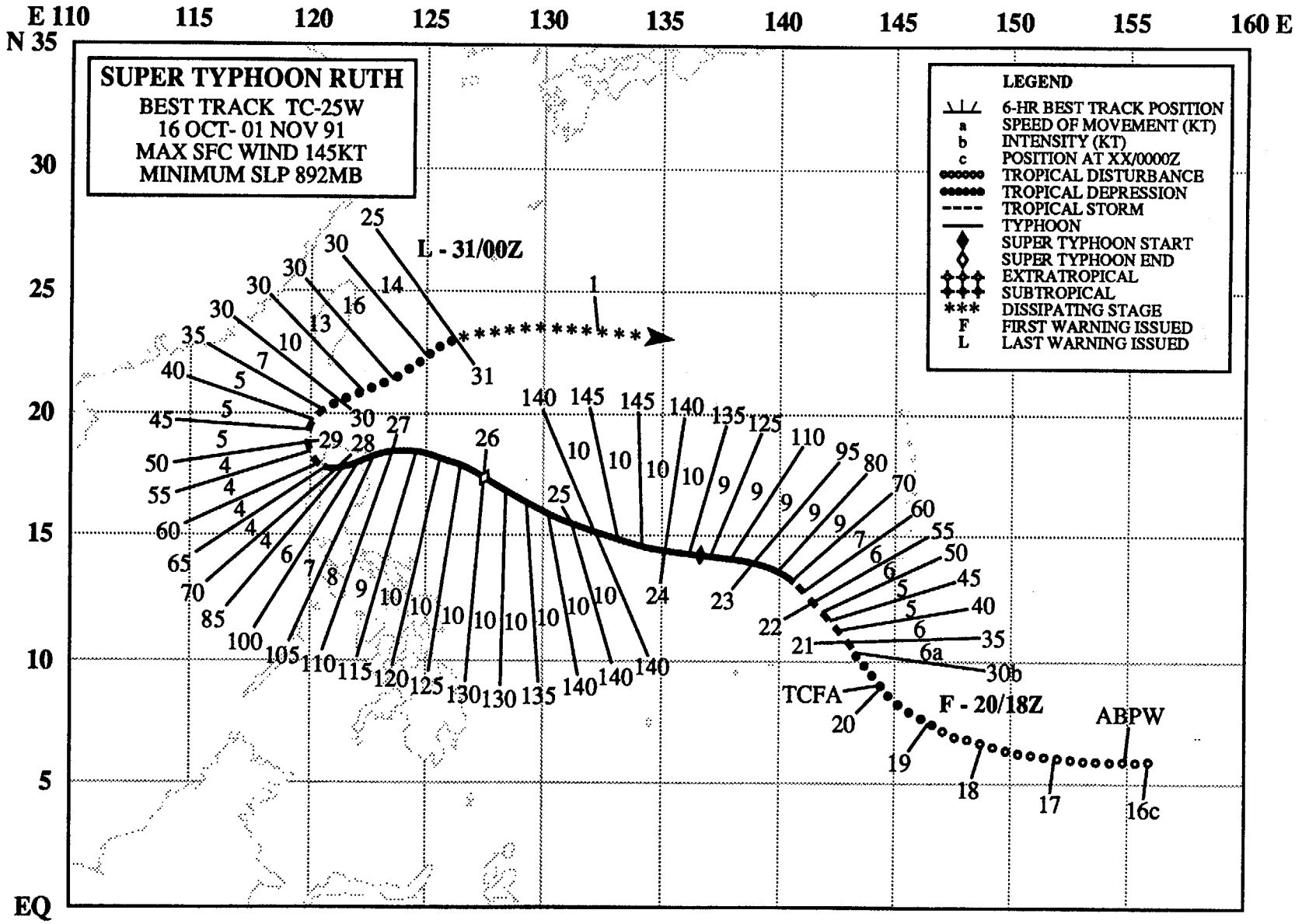
SUPER TYPHOON RUTH
BEST TRACK TC-25W
16 OCT- 01 NOV 91
MAX SFC WIND 145KT
MINIMUM SLP 892MB
LEGEND
6-HR BEST TRACK POSITION
SPEED OF MOVEMENT (KT)
INTENSITY (KT)
POSITION AT XX/0000Z
TROPICAL DISTURBANCE
TROPICAL DEPRESSION
TROPICAL STORM
TYPHOON
SUPER TYPHOON START
SUPER TYPHOON END
EXTRATROPICAL
SUBTROPICAL
DISSIPATING STAGE
FIRST WARNING ISSUED
LAST WARNING ISSUED
L - 31/00Z
F - 20/18Z
TCFA
ABPW
E 110
115
120
125
130
135
140
145
150
155
160 E
N 35
30
25
20
15
10
5
EQ

SUPER TYPHOON RUTH (25W)

I. HIGHLIGHTS

Super Typhoon Ruth was the second most intense tropical cyclone of 1991. With regard to intensity, forecasters successfully used climatological analogs to anticipate Ruth's rapid deepening to super typhoon intensity in the Philippine Sea. However, in contrast, the track forecasts based on NOGAPS prediction of early recurvature had the largest forecast track errors of the year.

II. TRACK AND INTENSITY

Ruth appeared as a tropical disturbance with a closed circulation at the surface between Chuuk and Pohnpei. Observed pressure falls of 1 to 2 mb over the previous 24 hours persuaded forecasters to mention the disturbance on the 160600Z October Significant Tropical Weather Advisory as an area with fair potential for development. On 18 and 19 October, there was a steady increase in convection as the disturbance moved west-northwestward through the Caroline Islands. The increased convection prompted the issuance of a Tropical Cyclone Formation Alert at 200100Z. Based on a Dvorak intensity estimate of 25 kt (13 m/sec) and increased convective organization, the first warning on Tropical Depression 25W was issued at 201800Z.

Figure 3-25-1. Ruth at super typhoon intensity in the Philippine Sea (231816Z October NOAA infrared imagery).

Ruth intensified steadily as it moved northwestward between Guam and Ulithi. On 22 October, an eye formed as the tropical cyclone "stair stepped" westward. After assuming a west-northwestward track across the Philippine Sea, Ruth rapidly intensified, reaching super typhoon intensity only 30 hours after its eye first appeared on satellite imagery (Figure 3-25-1). Ruth's track and explosive intensity increase were

consistent with climatological guidance. Nine analog tropical cyclones from a 20-year data set (Table 3-25-1) were found. Six of the nine had rapidly intensified to super typhoon intensity, and the majority had maintained a west-northwest track across the Philippine Sea. Ruth's intensity peaked at 145 kt (75 m/sec) at 240600Z and then slowly weakened as the typhoon approached northern Luzon. During this weakening phase, the eye expanded from a diameter of 10 nm (19 km) to 60 nm (110 km).

On 25 October, a mid-tropospheric trough moving eastward from China temporarily weakened the ridge and Ruth turned northwestward. Then the subtropical ridge re-established itself, and on 27 October Ruth tracked west-southwestward into northern Luzon. The typhoon lashed the northern coast of Luzon with winds in excess of 100 kt (51 m/sec) before weakening to tropical storm intensity over land. On 28 October another migrating mid-tropospheric trough, deeper than the previous one, picked up Tropical Storm Ruth and caused it to recurve south of Taiwan. The tropical cyclone continued to weaken as it moved northeastward, and JTWC issued the final warning on the system at 310000Z.

III. FORECAST PERFORMANCE

The track forecasts were excellent until 250000Z, when the forecast scenario changed from straight-running, west-northwestward to recurvature (Figure 3-25-2). Low track and intensity errors for the first 17 warnings had been a reflection of the climatological analogs.

Starting with the 231200Z dynamic model run, the NOGAPS prognoses began to deviate from the climatological track guidance by predicting early recurvature and then acceleration (Figure 3-25-3). Based on NOGAPS' previous successes, the forecast scenario switched from straight runner to recurver for the 250000Z through 261200Z warnings. When Ruth continued to move west-northwestward and the upper air analyses indicated 500 mb heights were rising over Taiwan, it became apparent that the NOGAPS guidance was erroneous. The result was six 72-hour forecast with errors in excess of 500 nm (925 km), including two over 900 nm (1665 km) - the largest busts of the year.

IV. IMPACT

Super Typhoon Ruth was the most intense tropical cyclone of 1991 to strike Luzon. On northern Luzon 12 people were killed as Ruth triggered numerous landslides and flooding leaving at least 76,000 residents homeless. Fortunately, very little rain fell near Mount Pinatubo where it would have caused mudflows, lahars, and additional devastation. At sea, 18 lost their lives when the freighter **Tung Lung** sank west of Taiwan. Another 18 crewman were rescued from heavy seas after the freighter

Table 3-25-1. Listing of nine analog tropical cyclones from 1970 to 1990 which had the greatest similarity to Ruth's track and intensity, along with their 24-, 48-, and 72-hour track and intensity change.

TC	DTG	INITIAL PSN (INT)	24 HOUR MOVMT (INT)	48 HOUR MOVMT (INT)	72 HOUR MOVMT (INT)
Ruth	91102118	12.0N 142.0E (50)	NW at 7 kt (80)	W at 9 kt (135)	WNW at 10 kt (140)
Irma	71111106	11.2N 139.4E (60)	NW at 15 kt (95)	NW at 15 kt (150)	NW at 9 kt (120)
Patsy	73100706	13.4N 140.8E (45)	WNW at 7 kt (65)	WNW at 9 kt (95)	WNW at 10 kt (140)
Louise	76103112	11.0N 142.1E (50)	W at 12 kt (75)	WNW at 14 kt (135)	WNW at 13 kt (140)
Kim	77110800	13.2N 147.4E (50)	W at 15 kt (95)	W at 14 kt (120)	W at 10 kt (120)
Tip	79100906	12.7N 145.8E (55)	W at 10 kt (85)	WNW at 6 kt (140)	NW at 7 kt (165)
Betty	80103006	11.7N 149.1E (55)	WNW at 20 kt (80)	W at 16 kt (95)	W at 11 kt (100)
Marge	83110118	13.6N 141.1E (45)	WNW at 8 kt (75)	WNW at 8 kt (130)	WNW at 7 kt (140)
Dot	85101400	11.6N 142.4E (50)	W at 12 kt (75)	WNW at 10 kt (140)	W at 13 kt (150)

Southern Cross sank northeast of Taiwan.

The large track forecast errors resulted in a short notice for DOD assets on northern Luzon to prepare for the typhoon and unnecessary typhoon preparations from Okinawa to Japan.

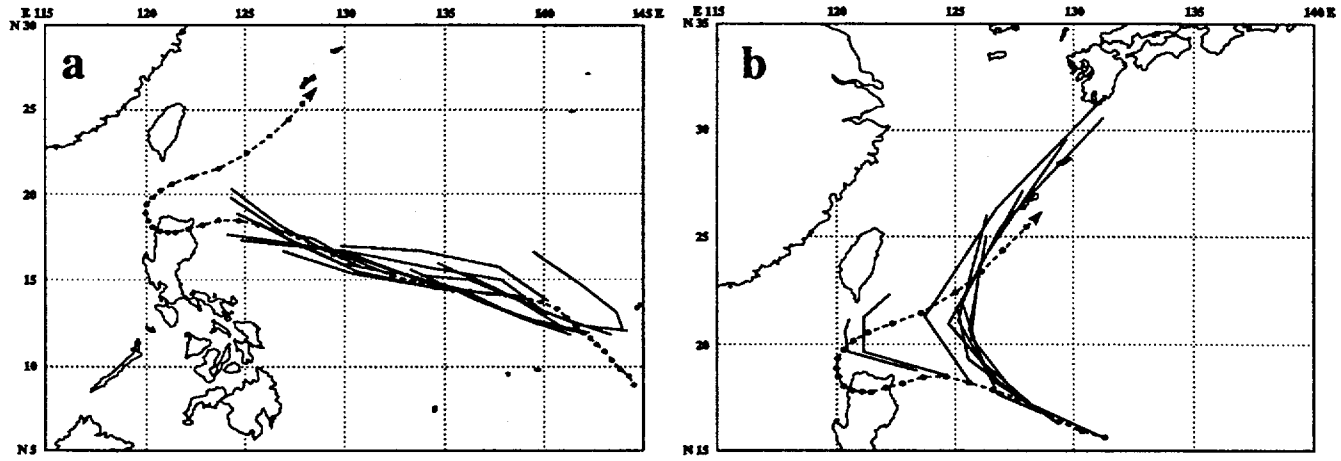

Figure 3-25-2. (a) Comparison of the first 17 warnings (201800Z to 241800Z) to the official JTWC best track and, (b) comparison of the next nine warnings (250000Z to 270000Z) to the official JTWC best track.

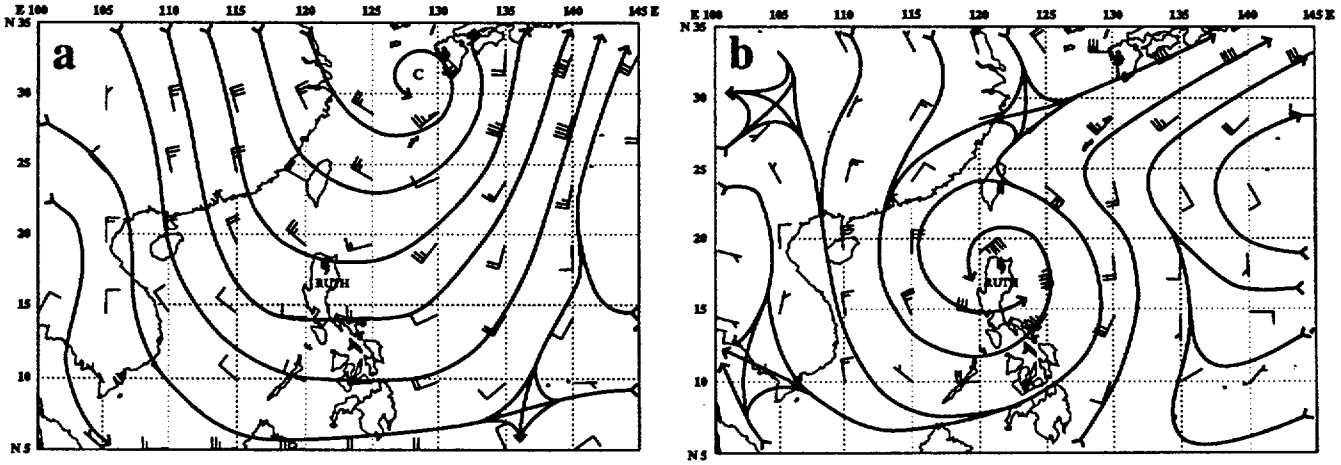

Figure 3-25-3. (a) Comparison of the NOGAPS 250000Z 700-mb 72-hour forecast, valid at 280000Z, to the (b) verifying NOGAPS analysis at 280000Z.